(19) Europäisches Patentamt
European Patent Offi
Office européen d s brevets

(11) Publication number : 0 672 803 A2

(12) EUROPEAN PATENT APPLICATION

(21) Application number : 95104087.2

(22) Date of filing : 20.03.95

(51) Int. Cl.[6] : E04B 1/80

(30) Priority : 18.03.94 DE 4409416

(43) Date of publication of application : 20.09.95 Bulletin 95/38

(84) Designated Contracting States : AT BE CH DE DK ES FR GB IT LI LU NL SE

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(54) Mineral wool insulating board, its use, and method for producing it.

(57) An insulating board on the basis of mineral wool bonded by a curable binding agent is characterised in that in between the mineral fibers of the minerals wool, non-metallic fibers (28) of a different kind are incorporated in at least one thickness area in an essentially homogeneous distribution, said fibers of a different kind having a greater average length and tensile strength than the mineral fibers of the mineral wool. The fibers (28) of a different kind are formed such as to be essentially rectilinear or have a large-radius curvature and are formed of portions of textile glass fibers separated at least in a high degree. Incorporation of these fibers (28) of a different kind having greater mechanical strength by bonding them inside the structure of the mineral wool by means of said binding agent surprisingly results in an increased resistance against pressure, notwithstanding the fact that all of the fibers are still largely aligned in parallel with the supporting surface. This improved resistance against pressure becomes particularly conspicuous at higher pressure loads bringing about deformations of the insulating board. In the method for producing such an insulating board, the mineral wool fibers are blended with the fibers (28) of a different kind, which are for at least the most part present as individual fibers, on their trajectory towards the r ception means.

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The inv ntion conc rns an insulating board on the basis of a mineral wool bonded with a curable binding ag nt in accordance with th preambl of claim 1, its use in accordance with claim 7, its embodiment as a multi-layer board in accordance with claim 8, its use in accordance with claims 12, 13 and 14, as well as a method for producing it in accordance with claim 15.

In order to obtain mineral wool insulating boards, mineral fibers are produced from a molten material by means of fiberizing units and deposited on a reception means inside a chute following their solidification. The reception means has the form of a production conveyor and continuously carries the fibers compiled into a layer of mineral wool and thus forming a mineral fiber web. Most commonly, a binding agent is distributed inside the mineral wool while still in the chute, with this binding agent imparting mechanical strength to the web of wool after curing.

As a result of such deposition, the large majority of fibers are deposited while having an orientation wherein their longitudinal extension is in parallel with the receiving surface. Only comparatively few fibers have their longitudinal extension in the height direction of the web. In order to form a mineral wool insulating board, the mineral fiber web thus produced by deposition and provided with binding agent is taken into a curing oven where the binding agent is cured in order to preserve this shape of the web and to impart mechanical strength to it.

Due to the described fiber orientation, however, the mechanical strength against pressure acting on the large surface of the insulating board is only relatively low. For, with respect to the desired insulating effect, high compression of the mineral fiber web for the purpose of forming a high-strength insulating board cannot be made use of to such an extent as to result in solid mutual support of the horizontally aligned fibers. The spaces required for insulating purposes can, hoewver, not contribute to supporting the fibers having a generally horizontal orientation when pressure is applied.

Several applications do, however, require a relatively high resistance against pressure of the insulating boards. This is the case e.g. if the insulating boards should be capable of being walked on or otherwise resisting local application of pressure. The resistance against pressure of such insulating boards is measured by means of a test apparatus which determines the compression rate in accordance with the compressing force.

Apart from resistance against pressure, tensile strength in the direction perpendicular to the board large surface is relatively low for analogous reasons. When a pull acts on the board large surface, as may occur e.g. in applications involving flow dynamics or du to suction ng nder d by wind at outer walls of buildings, th occurring tensil forces may bring about delamination of surface ar as of the insulating board. In this r spect, the term "r sistanc against pr ssure" shall generally ncompass t nsile strength in a direction opposite to compressive load in the framework of this patent specification.

Correspondingly, improving the resistance of mineral wool insulating boards to compression has heretofore been a central problem with a view to specific applications. Up to the present, two ways of proceeding became known in order to increase resistance against pressure of a mineral fiber board without, however, increasing its apparent density and/or binding agent content in an unacceptable degree: the concepts of the lamellar board on the one hand and the crimped board on the other hand.

In order to produce a lamellar board, a conventional mineral fiber board is cut to strips having a width corresponding to the height of the board to be produced. These strips are then rotated by 90° and thus recombined in order to form the board. In a lamellar board thus formed, the fiber orientation generated during deposition is therefore tilted by 90°, whereby fibers which were perpendicular to the plane of cutting are now erect in the height direction and thus result in a fiber orientation which is capable of receiving considerably higher pressure loads.

In order to form a crimped board, the web is compressed lengthwise prior to curing of the binding agent, whereby a part of the fibers having a lengthwise orientation are upset or caused to stand erect and thus arrive at an orientation in height direction. Curing of the binding agent and thus solidifaction of the mineral wool material is carried out while in this position.

In either case, increasing the resistance against pressure is achieved by means of a preferable fiber orientation in height direction of the insulating board, i.e. in the direction of a heat flow, coinciding with the desired direction of the board's insulating effect. Apart from further drawbacks such as expenditure, reduced resistance against pressure in a direction parallel to the large surfaces etc. there results in both techniques a quite considerable decrease of the insulating effect due to the fact that the fiber contents aligned in the height direction, in a manner of speaking, form a multitude of minute thermal bridges.

The invention, on the other hand, is based on the objective of furnishing an insulating board in accordance with the preamble of claim 1 which has an increased resistance against pressure, however without the necessity of an unacceptable trade-off against the insulating effect.

This object is attained by the characterising features of claim 1.

Incorporating fibers having a gr at r length and mechanical strength, and bonding th m in the structur of the mineral w ol by means of the binding agent surprisingly results in an increased r sistance against

pressure, notwithstanding th fact that all of the fibers are still aligned in parallel with th supporting surface. This improved r sistance against pressure becomes particularly conspicuous at higher pressure loads resulting in deformations of the insulating board. The reason for this surprising increase in mechanical strength even without a higher content of fibers being aligned in the height direction is presumed to reside in a bracing effect caused by the fibers of a different kind. According to this theory, the fibers of a different kind which project out of the pressurised surface area are subjected to increased tension when the surface area receives a pressure load and is deformed, which tension is intercepted inside the structure of the mineral wool at a distance from the pressurised surface area thanks to bonding of the external ends of the pressurised fibers by the binding agent, and which thereby increasingly supports the pressurised surface area as the amount of deformation increases. Consequently, the pressure load would increasingly be converted to a tensile load on the fibers of a different kind with increased penetration of the pressure load, this tensile load in turn being intercepted inside the undisturbed mineral wool structure at a distance from the pressurised surface area.

When the material of the fibers of a different kind is suitably chosen, there is not necessarily any degradation of the insulating effect of the insulating board of the invention. But even when a material having a higher thermal conductivity is used in order to improve tensile strength or processing properties of the fibers of a different kind, the decrease of the thermal insulation effect may be kept low, for the fibers of a different kind, in order to have the described effect, also should only be aligned essentially in parallel with the support surface inside the mineral wool material, thus crossing the direction of the thermal flow and only minimally contributing to an increased thermal flow even in the case of material having higher heat conductivity.

In comparison with the former problem solutions - lamellar board or longitudinally compressed board - there is furthermore the advantage of minimum production expenditure, as merely part of the mineral fibers need to be replaced with the fibers of a different kind, and without the necessity of carrying out subsequent expensive method steps on the deposited fibers. The high resistance against longitudinal compression of the insulating board thus produced - i.e. resistance against pressure parallel to the large surfaces - is furthermore unaltered, such that the increased resistance against pressure is not at the expense of a noticeable loss of mechanical strength in a different location.

It has already been attempt d to improv the needling properties of rock wool material by adding to th rock wool filaments of a differ nt kind having great r length and particularly higher flexibility which are entangl d during the process and thus impart mechanical strength to the needle-process d felt. In this case, the filaments of a different kind are restricted to their function of a needling aid and would thus be meaningless when the rock wool is solidified by curing of a binding agent.

In the case where the fibers of a different kind according to claim 2 are essentially rectilinear or have a large-radius curvature in their longitudinal extension, they are rapidly subjected to tension when the surface is pressurised, causing them to become effective after only a small depression of the surface. If, however, strongly deformed fibers such as e.g. curled fibers are used, then the loops formed by these fibers first have to be straightened before noticeable tension forces may be transmitted, wherefore a corresonding solidification occurs only after major deformation.

According to claim 3, the fibers of a different kind are preferably formed of portions of textile glass fibers separated at least in a high degree. Hereby fibers of a different kind having a suitable consistency may be obtained in a cost-effective manner. Textile glass fibers are, for example, available in the form of so-called rovings having a large variety of material properties. This makes it possible to select a suitable type of glass fiber for any purpose of the insulating board.

The contents of the fibers of a different kind indicated in claim 4 were found to be advantageous. With higher contents of fibers of a different kind, the mechanical strength of the matrix of the mineral wool material tends to decline, thereby degrading anchoring of the fibers of a different kind, whereas only part of the efficiency of the fibers of a different kind may be obtained if their contents are lower.

The upper limit of approximately 200 kg/m^3 for the apparent density indicated in claim 5 results in a sufficiently tight mineral fiber compound in order to well anchor the fibers of a different kind, and optimum increase of the mechanical strength through the measures of the invention. Below an apparent density of 200 kg/m^3 the mechanical strength gradually drops, however an improved thermal insulating ability of such a lighter insulating board may result.

When the fibers of a different kind are, according to claim 6, arranged in the mineral wool material only in one layer, particularly in an outer layer of the insulating board in a distribution which is essentially homogeneous, then besides a correspondingly increased resistance against pressure only a unilateral increase of the tensile strength of the insulating board is achieved, such that the insulating board has improved resistance against tear or delamination upon bending with th reinforced lay r turned to the outside, however does not have increased strength against forces acting parallel to the large faces on the insid . Such a board provides good bending around

curved surfac s without damage, in a given case support d by incorporated gro ves r fl xing zones.

Use of the insulating board of the invention according to claim 7 as a top layer for a multi-layer board including a base layer which has lower mechanical strength renders the advantages of the invention even more conspicuous. For in such a case, the top layer can yield not only due to compression while positioned on a rigid support, but also due to deflection in response to pressurisation, and thus presents even stronger tensional stabilisation of the pressurised surface area.

This concept may be implemented in a homogeneous product by forming a multi-layer board according to claim 8, such that the described advantages automatically become obvious without intervention on the side of the user.

According to claim 9, the base layer preferably has a lower apparent density and is thus rather optimised with a view to the thermal insulation effect. This is made possible by the fact that tasks implying mechanical strength concentrate on the top layer.

According to claim 10, the ratio of top layer and base layer thicknesses is preferably in the range between 1:2 and 1:10, with the base layer anyway having the larger thickness. This ensures full effectivity for the better thermal insulation effect of the base layer, whereas the top layer may contribute to mechanical strength even at relatively small thicknesses. Where the top layer thus has a smaller thermal insulation effect, a resulting decline of the insulating board's total thermal insulation effect is only minor.

Wenn the base layer according to claim 11 has at least been partly crimped, i.e. compressed in its longitudinal direction, the specific insulating ability is neglected to thus obtain an extremely pressure-resistant board wherein the top layer which is internally braced by tension is supported and additionally secured against further deformation by a pressure-resistant, longitudinally compressed layer.

Use of an insulating board or multi-layer board of the invention according to claim 12 as a roof insulating board for a flat roof makes use of the increased resistance against pressure without necessarily reducing the thermal insulating ability in a manner optimally suited for practical use. Use as an insulating board for outer walls of buildings according to claim 13 makes corresponding use of the increased tensile strength in a direction transverse to the large surface of the board for higher stability against suction engendered by wind. The insulating board according to claim 6 is particularly suited for insulating curved surfaces, for example as a so-called grooved board, i.e. a board allowing articulation of the board sections separated by such grooves, or preferably a board comprising flexing zones for chimn y insulation, inasmuch as the str ngthened outer layer counteracts the t ndency towards delamination occurring on the outsid of the curvature in such applications.

Th production method according to claim 15 assur s minimum additional exp ns during production. Addition of the fibers of a different kind inside the chute, possibly together with the binding agent where the latter is not introduced later on, merely necessitates admixing means without otherwise interfering with the process in any other location.

Homogeneous distribution of the fibers of a different kind reduced to layers for forming an insulating board according to claim 16 results when the fibers are added only in one portion of the reception means having a limited width in transport direction, preferably in the section where the mineral wool material leaves the chute. Claims 17 and 18 represent embodiments of the method, the advantages of which result from the preceding description.

When, according to claim 19, as a preliminary stage for forming the fibers of a different kind, textile glass fibers are cut into sections of 40 to 60 mm, preferably 50 mm length before being separated into individual fibers, this results in a particularly favorable process management for production of the fibers of a different kind, as separating them into individual fibers is carried out in a simple manner only after preliminary cutting.

The method for producing a multi-layer board according to claim 20 also requires minimum additional expenditure when compared with conventional production of a multi-layer board. The fiber contents according to claim 21 thus resulted in favorable anchoring in the top layer, however at a relatively small modification of consistency compared with a conventional mineral wool layer.

Further details, aspects and advantages of the present invention result from the description following below while making reference to the drawing, wherein:

Fig. 1 is a sectional side view of the upper portion of a chute for producing mineral wool according to the blast drawing method, with this upper portion being designed for producing an embodiment of a mineral wool insulating board according to the invention;

Fig. 2 is a schematically simplified sectional view of the lower portion of a chute for producing mineral wool, with this lower portion being designed for producing another embodiment of a mineral wool insulating board according to the invention;

Fig. 3 is a perspective view of a mineral wool insulating board for use as a grooved board according to the invention and produced by the method according to Fig. 2; and

Fig. 4 is a sectional view of a mineral wool insulating board according to Fig. 3 when used as a chimney insulating board.

A method for producing a web or board of mineral wool bonded by means of a curable binding agent,

wherein the web or board is r inforced by homogeneously distributed fibers of a diff r nt kind, g nerally is as follows:

Fig. 1 of the drawing shows the head area of a chute. The molten mineral material is supplied from a melting end (not shown) to two distributing vats 2 in laterally adjacent arrangement, each comprising a row of outlets 4 for the molten material. The distributing vats 2 are made of platinum in the usual manner and maintained at a desired temperature by means of flame heating arranged in lateral cavities 6.

Underneath the outlets 4, as is basically common in the blast drawing method, blast nozzle means 8 are arranged and consist of two respective blast nozzle halves 10 and an intermediately arranged nozzle orifice through which the primary filaments of the molten material emanating from the outlets 4 pass while following the trajectory lines shown in the drawing and being fiberised by a propellent gas which is provided at positive pressure inside cavities 16 of the blast nozzle halves 10, and impelled by way of injection slots not shown in the drawing into the nozzle orifice 12. The principle of the processes taking place therein are known to the person skilled in the art.

At the lower outlet side of the blast nozzle means 8 in the drawing, divergent flow zones emanate which contain propellent gas, secondary air sucked in by the injection effect of the injected propellent gas from the upper side of the blast nozzle means 8, together with combustion gases from the cavities 6, and the newly formed fibers still having a high temperature. The flow zones arrive inside guide conduits 18 converging in the manner of nozzles, whereby at their upper side secondary air is again sucked in for further cooling, and the mixture of fibers and gas thus formed emanates at the outlet opening of the guide conduits 18 while again being focused in divergent flow zones 20. In the area of the lower end of guide conduits 18, the spray nozzles 22 for injecting binding agent such as phenolic resin having a fluid consistency are arranged.

The flow zones 20 enter in to a chute shown under 24 wherein the dropping fibers are cooled and distribute over the cross-section of the chute, such as to be homogeneously deposited as a web on a conveyor belt not shown in Fig. 1 located at the lower end of the chute 24.

The method processes mentioned above and the mentioned construction of a blast drawing nozzle, respectively, are known to the person skilled in the art.

In order to produce the board of the invention, another means is provided whereby non-metallic fibers 28 of a different kind for the most part present in the form of individual fibers are added to the fibers produced inside th flow zones 20 by m ans of the blast drawing method. These individual fibers 28 have a defined length and preferably consist of portions of textile glass fib rs s parat d in a high degre and having the form of rovings. Th se portions of textile glass fib rs separated in a high degre are supplied to the flow zones 20 b tween th low r apertur of the guide conduits 18 and the spray nozzles 22 for the binding agent by means of another supply means 26 which operates in the manner of a spray nozzle. The fibers 28 emerging from the supply means 26 are carried off by the flow zones 20 emanating from the guide conduits 18 and blend intimately with the flow zones 20, while wetting with the binding agent issuing from the spray nozzles 22 is simultaneously carried out. The mixture of mineral wool, added individual fibers 28, and binding agent depositing at the lower end of the chute 24 constitutes a continuous web on that conveyor belt. The individual fibers - as was already explained at the beginning - are preferably formed such as to be essentially rectilinear or curved at a large-radius curvature. Due to this shape, they rapidly receive a tensile load when the surface is pressurised, and become effective when the surface is depressed even only by a small amount. Representation of the fibers 28 of a different kind in Fig. 1 as wavy or curled fibers has the purpose of improved visualisation of the fibers 28 of a different kind inside the flow zones 20.

This continuous web is carried off from the chute 24 by the conveyor belt and subsequently cured inside a tunnel furnace, in a given case preceded by compression in the height or thickness direction of the web.

In order to produce a multi-layer board consisting of a top layer and a base layer, wherein the top layer is formed by an insulating board produced in accordance with the method just described, and the base layer is a normal mineral wool, i.e. without the addition of fibers of a different kind, the two layers of the web or board are produced in accordance with a production method in two separate steps. The base layer to be later on superposed on the top layer having greater mechanical strength is produced by a known method, for example a blast drawing or centrifuging method, wherein a molten rock or glass starting material is attenuated into thin filaments and, having been provided with a binding agent, finally deposited on a gas-permeable reception means having the form e.g. of an endless rotary conveyor belt or a drum.

The layer to form the top layer later on is analogously produced in a separate station by the method explained by referring to Fig. 1. Here, however, on their path to the reception means, the fibers for the top layer receive not only the binding agent but also the addition of fibers of a different kind largely present in the form of individual fibers.

The two layers thus produced, i.e. the base layer of mineral wool which comprises uncured binding ag nt, and the top layer of mineral wool, the additional fibers 28 of a different kind and the as yet uncur d binding agent, are then sup rposed by suitable meas-

ures such as to align their dges, and curing of the binding agent is carri d out in a subsequent curing station concurrently with the bonding tog ther of base layer and top layer. The web or board thus produced thus includes the base layer without the additional fibers and the top layer comprising the additional fibers 28. The base layer preferably has a smaller apparent density than the top layer. The apparent density of the base layer is approximately 150 kg/m^3 or less, whereas the apparent density of the top layer is approximately 200 kg/m^3 or less.

As mentioned above, the additionally provided individual fibers 28 preferably are separated portions of textile glass fibers. For this purpose, bundles of glass fibers, or so-called rovings, are cut into portions of approximately 40 to 60 mm, preferably approximately 50 mm length, after which the cut bundles of glass fibers are separated into individual fibers by suitable measures. The individual fibers 28 are then, in the course of producing the top layer, injected concurrently with the binding agent into the flow zones 20 of the mineral wool fibers already produced. The content of the individual fibers 28 in the top layer is less than 40%, preferably approximately 20% or less, in particular approximately 10%. Due to the additional individual fibers 28 having a greater average length and tensile strength than the mineral wool fibers, there results an increase in resistance against pressure, although all of the fibers are as before mainly aligned in a direction parallel to the support surface. This improved resistance against pressure makes itself felt particularly at increased pressure loads bringing about deformations of the insulating board. The reason for this increased mechanical strength, even in the absence of an increased content of fibers oriented along the height direction, presumably is due to a bracing effect by the fibers of a different kind. Accordingly, the fibers 28 of a different kind projecting out of the pressurised surface area are subjected to increased tension by pressure load and deformation of the surface areas, with this tension being intercepted inside the structure of the mineral wool at a distance from the pressurised surface area due to bonding of the outer ends of the pressurised fibers with binding agent, and which thus increasingly supports the pressurised surface area at increasing deformation. The pressure load is thus at increasing penetration of the pressure load more and more strongly converted into a tensional load on the fibers 28 of a different kind, which in turn is intercepted inside the undisturbed structure of the mineral wool at a distance from the pressurised surface area. The fibers 28 of a different kind preferably have a rectilinear form or a large-radius curvatures in their longitudinal extension. Thus a tension load is rapidly applied to them due to a pressure load on the surface, such that the mechanisms d scribed above take eff ct even after a slight depr ssion of th surface. If, on the other hand, strongly deformed fibers such as curl d fibers were used, the loops formed by these fibers would at first have to be straightened before noticeabl tension forces can be passed on, and a corresponding strenghtening would occur only after a larger amount of deformation.

The improved stiffness resisting bending, in turn, makes it possible for the top layer of the mineral wool board e.g. to be walked on without damage to the board surface. A mineral wool board produced by the method of this invention may thus preferably be used as a roof insulating board, but also as an insulating board for outer walls of buildings, because it is also capable of neutralising horizontal forces such as suction engendered by wind.

The ratio of top layer and base layer thicknesses depends on the concrete purpose of use, however is within a range between approximately 1:2 and approximately 1:10. In order to obtain further improvement of the mechaniccal properties of the entire board, the base layer may also be partly compressed in the longitudinal direction.

An advantageous side effect of introducing additional fibers 28 into the flow zones 20 before it is wet with the binding agent is the fact that the temperature of the flow zones 20 may be further reduced by means of the additionally introduced fibers 28 and/or the additionally injected stream of air carrying along the fibers 28, such that the thermal load on the binding agent upon contact with the hot fibers is reduced.

Fig. 2 shows in a schematically simplified manner the arrangement for producing an insulating board wherein the fibers 28 of a different kind - just like in the above described production method - are arranged in one layer of the insulating board, preferably an outer layer. Contrary to the method mentioned by referring to Fig. 1, in the method and arrangement, respectively, of Fig. 2 the mineral wool web provided and reinforced with the non-metallic fibers 28 of a different kind is produced concurrently with the mineral wool web that is not provided with the fibers of a different kind. Separate production of an insulating board reinforced with the fibers of a different kind and an insulating board without reinforcement, and subsequent bonding together of these separately produced insulating boards in order to obtain a multi-layer board comprising a top layer and a base layer is thus not necessary in the method or arrangement according to Fig. 2. In Fig. 2, as well, the fibers 28 of a different kind are represented in the form of wavy or curly fibers for reasons of better visualisation of the fibers 28 compared to the mineral wool fibers only. Under practical circumstances, the fibers 28 of a different kind preferably have an essentially straigth shape or large-radius curvatures in their longitudinal xtension.

Fig. 2 shows the bottom end or th lower part of the chute 24. A blast nozzle device having the construction shown in Fig. 1 produc s min ral wool fib-

ers 30 provided with binding ag nt and sends them downwards to gas-permeable r ception means position d underneath and having th form e.g. of a production conveyor 32. The production conveyor 32 transports the deposited mineral wool fibers 30 in the direction of the arrows from an outlet opening 34 of the chute 24 to the subsequent processing stations. As the mineral wool fibers 30 deposited on the conveyor 32 are transported from the left side to the right side of Fig. 2, and due to the depositing stream of mineral wool fibers 30 being essentially constant and homogeneous over the cross-section of the chute 24, the layer thickness of the deposited mineral wool fibers 30 in Fig. 2 also increases continually from the left to the right side.

In a lower end portion near the opening 34, there is provided a plurality of spray nozzles 22 each supplied with the non-metallic fibers 28 of a different kind via a conduit 36. These fibers 28 of a different kind thus enter into the flow of mineral wool fibers 30 arriving from the blast nozzle means to intimately blend with them. On a layer 38 entirely consisting of solely mineral wool fibers plus binding agent, another layer 40 consisting of mineral wool fibers 30 plus the fibers 28 of a different kind plus binding agent is deposited. The two overlying layers 38 and 40 are transported to a downstream finishing station shown in Fig. 2 where the layers 38 and 40 are possibly compressed somewhat more and then pass through a tunnel furnace. The final product is a multi-layer board 42 consisting of the base layer 38 of mineral wool fibers only, and the top layer 40 wherein the non-metallic fibers 28 of a different kind are present together with the mineral wool fibers 30. Thanks to the top layer 40 comprising the fibers 28 of a different kind, such a multilayer board 42 may receive a high load such as persons walking or vehicles driving on it, and is furthermore suited for use as an insulating board, even an insulating board for outer walls of buildings, for due to the pressure-resistent top layer 40, the multi-layer board 42 can also easily resist wind suction forces when used as an insulating board for outer walls of buildings.

Other than in the production method discussed with reference to Fig. 1, in the method or arrangement according to Fig. 2, as well, production of the base layer 38 and the top layer 40 is carried out in one step, making the bonding together of separately produced top and base layers for obtaining a multi-layer board in the method or arrangement shown in Fig. 2 unnecessary.

It will be understood that the arrangement shown in Fig. 2 should be taken to be only an example. The spray nozzles 22 might as well be positioned on the l ft-hand sid of the chute 24 in Fig. 2. Th result would b the production of a multi-layer board the top lay r 40 of which li s on the production conv yor 32 and the base layer 38 of which is d posit d on the top layer 40. It is also conceivabl to have th spray nozzles 22 arranged for xampl in th mann r of a slotted nozzle having a drop-shaped cross-section extending across the entire width of the chute 24, and to then position this slotted nozzle between the two walls represented in Fig. 2, namely the front wall 44 and the rear wall 46 of the chute 24, i.e. in a generally central position within the stream of mineral wool fibers 30 issued by the blast nozzle arrangement. The resulting product would be a multi-layer board consisting of two outer layers of nothing but mineral wool fibers and a core layer consisting of mineral wool fibers 30 reinforced by the fibers 28 of a different kind. Vice versa it is also possible to provide spray nozzles 22 for outputting the fibers 28 of a different kind in the area of the front wall 44 as well as in the area of the rear wall 46. This would result in a multi-layer board wherein one layer of mineral wool fibers only is sandwiched between two outer layers consisting of the mineral wool fibers plus the fibers of a different kind. Such a multi-layer structure would without the binding agent also preferably be suited to thereby produce a needle felt having higher mechanical strength than those according to the prior art.

Fig. 3 shows the possible applications of a multilayer board 42 as a so-called grooved board. The grooved board 48 represented in Fig. 3 includes the base layer 38 consisting of mineral wool fibers 30 and the highly pressure resistant top layer 40 consisting of mineral wool fibers 30 plus the fibers 28 of a different kind. As is shown in Fig. 3, a plurality of wedgeshaped sections 50 is incorporated into the base layer 38, with the wedge-shaped sections 50 extending essentially as far as the area of the top layer 40.

Use of such a grooved board 48 is represented in Fig. 4. By means of this grooved board 48 a cylindrical object, for example a chimney pipe 52, may effectively be insulated. Depending on the diameter of the chimney pipe 52 or the longitudinal extension of the grooved board 48, one, two, three or more such grooved boards 48 are required in order to cover the entire circumference of the chimney pipe 52. Thanks to the wedge-shaped sections 50 in the base layer 38, the grooved board 48 may properly be applied to the outer circumference of the chimney pipe 52, with the wedge-shaped sections 50 closing in different degrees depending on the diameter of the chimney pipe 52. Fig. 4 shows the ideal case in which the inclination of the wedge-shaped sections 50 and the diameter of the chimney pipe 52 match so well that the wedgeshaped sections 50 close perfectly, leaving nothing but incisions 54 in the base layer 38.

Due to the layer acting as an outer or top layer 40 wherein the fibers 28 of a different kind are contained in essentially homog neous distribution among the mineral wool fibers 30, there is not only an increased resistance against pressure, but also a unilateral increas in t nsile strength of th multi-layer board 42

or grooved board 48, respectively, such that this board 42 or 48 presents improved resistance against splitting and delaminations when bent such as shown in Fig. 4 while the top layer 40 is arranged on the outside. As the base layer 38 consists of mineral wool fibers only, this base layer 38 does not have any increased strength against forces acting in parallel with the large faces. Even a multi-layer board 42 according to the invention lacking the the wedge-shaped sections 50 may thus, in a given case, be bent around less strongly curved surfaces without receiving damage.

Instead of the wedge-shaped sections 50, a number of flexing zones may, in a given case, be provided in the material of the multi-layer board in order to attain better pliability, in particular around more strongly curved surfaces.

Claims

1. Insulating board on the basis of mineral wool bonded by a curable binding agent, characterised in that in between the mineral fibers of the mineral wool (30) non-metallic fibers (28) of a different kind having a greater average length and tensile strength than the mineral fibers of said mineral wool (30) are incorporated in at least one thickness area thereof in essentially homogeneous distribution.

2. Insulating board according to claim 1, *characterised in that* said fibers (28) of a different kind are formed such as to be essentially rectilinear or have a large-radius curvature.

3. Insulating board according to claim 1 or 2, *characterised in that* said fibers (28) of a different kind having a defined length are formed of portions of textile glass fibers separated at least in a high degree.

4. Insulating board according to any one of claims 1 to 3, *characterised in that* the content of said fibers (28) of a different kind in the mineral wool is less than 40% by weight, preferably less than 20% by weight, in particular less than 10% by weight.

5. Insulating board according to any one of claims 1 to 4, *characterised by* an apparent density of approximately 200 kg/m³ or less.

6. Insulating board according to any one of claims 1 to 5, *charact ris d in that* said fibers (28) of a different kind are located only or at least most predominantly in on layer (40) of said insulating board, preferably an external layer.

7. Use of the insulating board according to any on of claims 1 to 6 for a multi-layer board (42) as a top layer (40) locat d on top of a base layer (38) having less mechanical strength.

8. Multi-layer board making use of the insulating board according to claim 7, *characterised in that* said two layers (38, 40) have been bonded together by curing the binding agent contained in these layers while being under pressure.

9. Multi-layer board according to claim 8, *characterised in that* the apparent density of said top layer (40) is approximately 200 kg/m³ or less, and the one of said base layer (38) is approximately 150 kg/m³ or less.

10. Multi-layer board according to claim 8 or 9, *characterised in that* the ratio of thicknesses of said top layer (40) and said base layer (38) is in the range between 1:2 and 1:10.

11. Multi-layer board according to any one of claims 8 to 10, *characterised in that* said base layer (38) has, at least partly, been crimped or compressed longitudinally.

12. Use of the insulating board according to any one of claims 1 to 6 or 8 to 11 as a roof insulating board.

13. Use of the insulating board according to any one of claims 1 to 6 or 8 to 11 as an insulating board for outer walls of buildings.

14. Use of the insulating board according to claim 6 as an insulation for curved surfaces, with the layer (40) containing said fibers of a different kind being located on the outside of the curvature.

15. Method for producing an insulating board according to any one of claims 1 to 6, said mineral wool of the board being formed by deposition of fibers (30) transported by a gaseous flow, on a gas-permeable reception means (32), *characterised in that* said mineral fibers (30) are blended with said fibers (28) of a different kind, which are for at least the most part present as individual fibers, on their trajectory towards said reception means (32).

16. Method according to claim 15, for producing an insulating board according to claim 6, *characterised in that* addition of said fibers (28) of a different kind from said chute (24) is implemented in a section of said rec ption means (32) having a limited width in the transport dir ction.

17. Meth d according to claim 15 or 16, *characterised in that* said fibers (28) of a differ nt kind are constituted by fib rs being essentially r ctilinear or curved at a large-radius curvature.

18. Method according to any one of claims 15 to 17, *characterised in that* said fibers (28) of a different kind having a defined length are constituted by portions of textile glass fibers which were at least partly separated.

19. Method according to any one of claims 15 to 18, *characterised in that* as a a preliminary phase of forming said individual fibers (28) of a different kind, textile glass fibers are cut to portions having a length of 40 to 60 mm, preferably 50 mm, prior to their being separated into individual fibers.

20. Method according to any one of claims 15 to 19 for producing a multi-layer board according to any one of claims 7 to 11, *characterised in that* said top layer (40) and said base layer (38) are prefabricated as separate mineral fiber webs and then superposed, and that said top layer (40) is bonded together with said base layer (38) by compressing the combined layers and curing the binding agent contained in these layers.

21. Method according to claim 20, *characterised in that* the content of said fibers (28) of a different kind in said top layer (40) is less than 20% by weight, preferably less than 10% by weight.

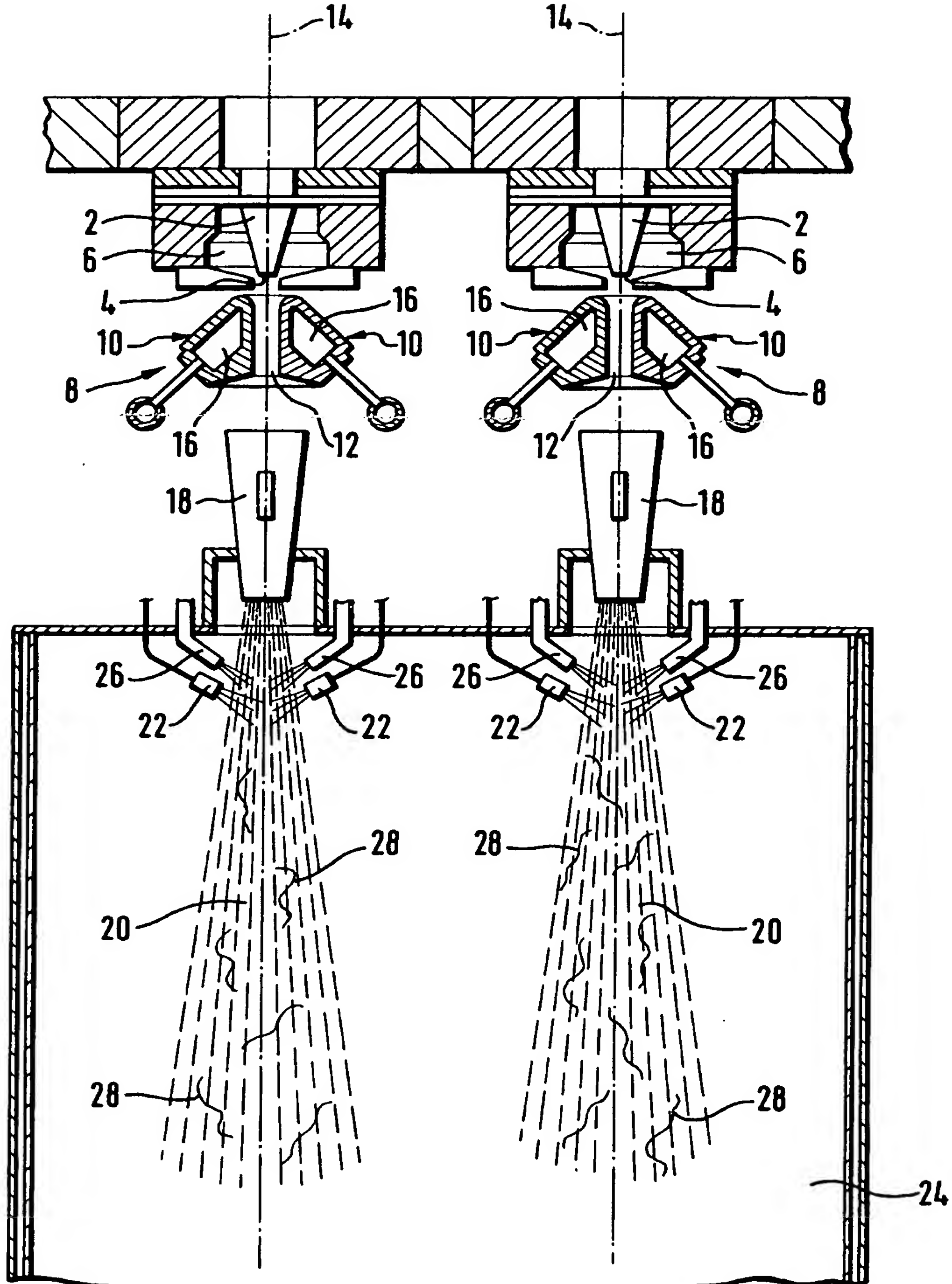
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Fig. 1

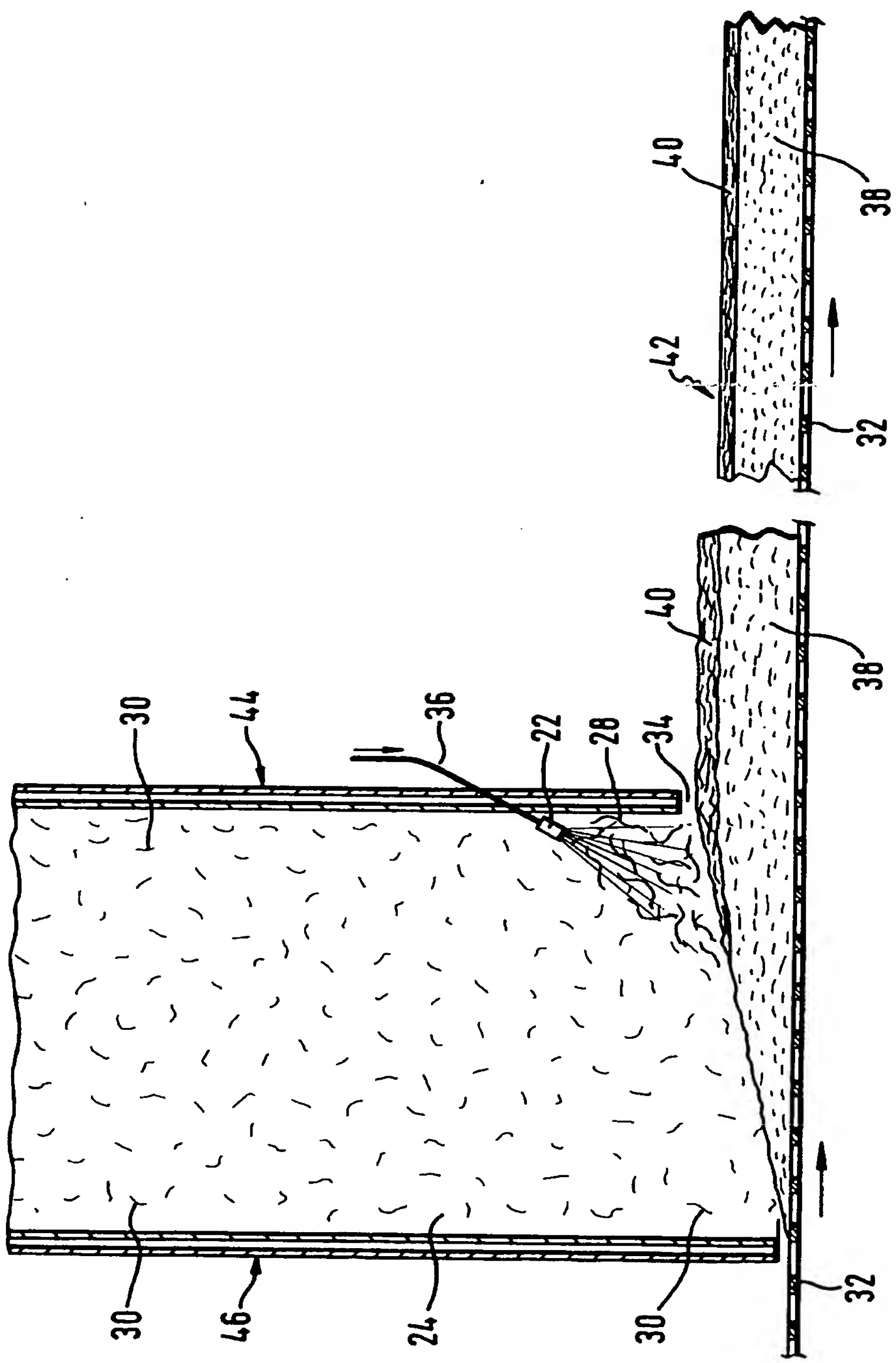

Fig. 2

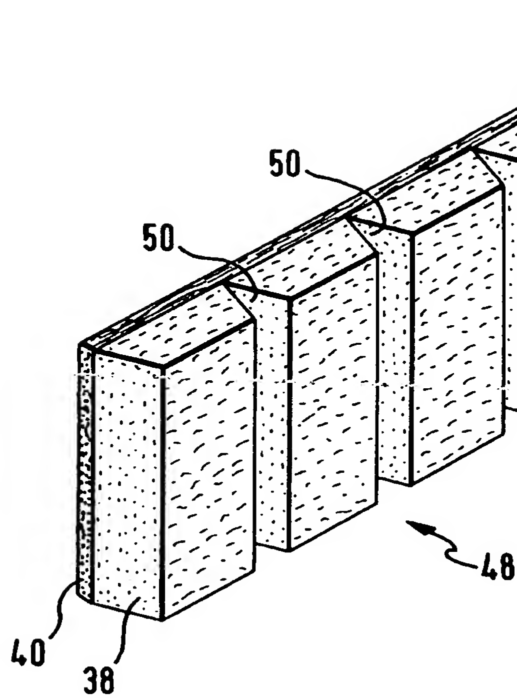

Fig. 3

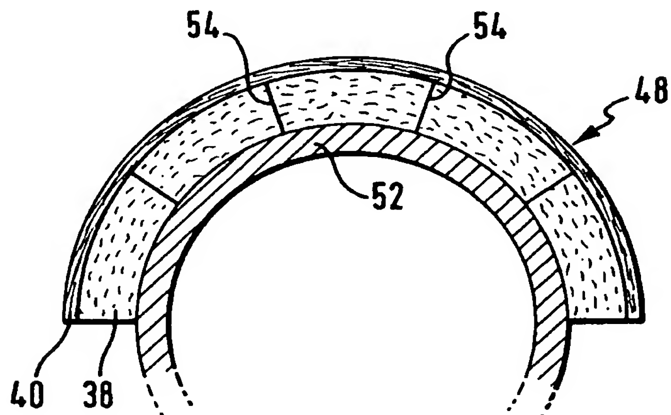

Fig. 4